Deaf Students’ Receptive and Expressive American Sign Language Skills: Comparisons and Relations

Jennifer S. Beal-Alvarez*
Valdosta State University

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This article presents receptive and expressive American Sign Language skills of 85 students, 6 through 22 years of age at a residential school for the deaf using the American Sign Language Receptive Skills Test and the Ozcaliskan Motion Stimuli. Results are presented by ages and indicate that students’ receptive skills increased with age and were still developing across this age range. Students’ expressive skills, specifically classifier production, increased with age but did not approach adult-like performance. On both measures, deaf children with deaf parents scored higher than their peers with hearing parents and many components of the measures significantly correlated. These results suggest that these two measures provide a well-rounded snapshot of individual students’ American Sign Language skills.

Recent legislations in education, including the No Child Left Behind Act (NCLB, 2002), Individuals with Disabilities Education Improvement Act (IDEIA, 2004), and the Common Core Standards (Common Core State Standards Initiative, 2010), as well as the new professional accreditation organization for teacher education programs in the United States (Council for the Accreditation of Educator Preparation [CAEP], 2010) call for data-driven instructional decisions and evidence-based practices that are aligned with students’ current skill levels. Data-driven decisions for students who are deaf and use sign language must begin with documentation of students’ current language skills and their language development over time as a foundation for instruction in areas for which language is critical for access (Allen & Enns, 2013). This article focuses on the receptive and expressive American Sign Language (ASL) skills of students who are deaf/hard of hearing (D/HH) from 6 to 22 years of age. The aim of this study was to document preliminary evidence for a new expressive ASL test and to describe receptive and expressive ASL grammatical abilities of children who are D/HH. Earlier researchers focused on language skills of younger children with deaf parents (Baker, van den Bogaerde, & Woll, 2008; Kantor, 1980; Schick, 1990; Supalla, 1982, 1986); this population does not reflect the majority of children who are D/HH (Mitchell & Karchmer, 2004), who encounter bilingual approaches (i.e., written English/ASL) at later ages (Mayberry & Eichen, 1991; Musselman & Akamatsu, 1999) and may continue to develop ASL skills long after their peers.

Variation in the D/HH Student Population

For successful literacy and academic skills, children need full access to a foundational language (Paul, 1998; Wilbur, 2000). Children who are D/HH frequently lack full access to a foundational language, because either they lack exposure to fluent sign language models (Lederberg & Everhart, 1998; Moeller & Luetke-Stahlman, 1990; Moeller & Schick, 2006; Schick, Williams, & Kupermintz, 2006) or they lack complete access to a spoken language (Perfetti & Sandak, 2000; van den Bogaerde & Baker, 2002). Without these foundational language skills, children may lack the necessary “automatization of lower-level language processing skills” required for academic success (Marschark et al., 2009, p. 366). Students who are D/HH fall along a communication continuum from listening and spoken
language to sign-supported speech, speech-supported sign language, and the use of ASL (Easterbrooks & Beal-Alvarez, 2013; Lederberg, Schick, & Spencer, 2013). According to the Gallaudet Research Institute’s (2011) survey of 37,828 D/HH students, 22% of them used sign language interpreting services in school, 28% of their teachers used only sign language for instruction, and 12% of their teachers used a combination of sign language and speech (simultaneous communication). In sum, 40% of students’ teachers used sign language during instruction.


Receptive ASL Development

Readily available receptive assessments, and therefore documented results, are sparse for children who use sign language (Singleton & Supalla, 2011; see Enns & Herman, 2011, and Haug, 2008 for an overview). Schick and colleagues (Schick, de Villiers, de Villiers, & Hoffmeister, 2007) developed the Receptive ASL Vocabulary Test (ASLVVT) based on the Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981). During administration a child watches a signed word or phrase and points to one of four pictures for 61 items. Schick and colleagues (2007) administered this assessment to 96 children between 4 and 7 years of age, half with deaf parents (DoDP) and half with hearing parents (deaf of hearing parent [DoHP]). On average, students’ scores increased with age, ranging from 60% to 77% correct, and DoDP, who likely had ASL models in the home, scored consistently higher than DoHP.

Enns and colleagues (Enns & Herman, 2011; Enns & Zimmer, 2009) adapted the Receptive Test of British Sign Language (American Sign Language Receptive Skills Test [ASL-RST]; Herman, Holmes, & Woll, 1999) to assess the receptive ASL skills of children ages 313 years who are native or near-native signers of ASL. The ASL-RST (Enns, Zimmer, Boudreault, Rabu, & Broszeit, 2013) measures skills across eight grammatical categories. In two pilot samples, children 313 years of age with deaf parents and no identified varying exceptionalities (i.e., disabilities beyond D/HH; Easterbrooks & Estes, 2007), scored between 4% and 90% correct, and score and age strongly correlated (r = .82). In their standardization study, Enns and colleagues (2013) combined most of the pilot children with a larger sample of native (i.e., DoDP; n = 77) or near-native (i.e., DoHP exposed to ASL by 3 years of age; n = 126) signers, all between 3 and 13 years of age, for a standardization sample of 203 children. Standard scores are presented across ages in their assessment manual (Enns et al., 2013). Allen and Enns (2013) investigated trajectories of grammatical categories across the young children (i.e., 3–5 years) and found that number-distribution, negation, and size-and-shape-specifiers (SASSes) had steeper learning slopes and greater levels of mastery when compared with the more complex categories of role shift, handle classifiers, and conditionals. No other information is available regarding categorical performance across school-aged children.

Some researchers developed assessments focused specifically on comprehension of ASL classifier structures. Enns and colleagues (Enns, Hall, Isaac, & MacDonald, 2007) assessed fourth and fifth grade students’ comprehension of classifiers using a 10-item picture task in which students selected one of four signed options that represented the object in the picture. Across 13 students, two students were in the acquisition phase, eight students “indicated a developing comprehension of ASL classifiers” and three students were approaching mastery of classifier comprehension (Enns et al., 2007, p. 9). Parental hearing status was not reported. Similarly, Schick and Hoffmeister (Schick & Hoffmeister, 2001a, 2001b) assessed 90 children,
4–7 years of age, using the Receptive Test of ASL Classifiers (Schick, 1997). About half of the students had deaf parents. Procedures are similar to the ASLVT (Schick et al., 2007). Children’s scores increased with age, from a mean of 62–76%, and DoDP outscored their DoHP peers. Schick and colleagues (2007) also assessed children’s comprehension of ASL syntax and morphology, such as verb agreement and morphological markers for people. Again, children’s scores increased with age and DoDP outscored DoHP. This is similar to findings that young DoDP children (2–3 years of age) comprehended (Lindert, 2002) and produced classifiers (Lindert, 2002; Kantor, 1980). For example, when mothers described objects in locative relations, children (2–4 years of age) correctly chose the objects nearly 70% of the time and they both imitated and spontaneously produced classifiers (Lindert, 2002). Similar to the result of Schick and colleagues (2007), their production increased with age. In sum, across current available studies, children’s ASL abilities increased with age and those who likely were exposed to fluent sign language models earlier and more frequently scored higher across ages and assessments.

However, this is a simplified picture that forgoes various other factors that affect language comprehension. These factors include age at identification of hearing loss, provision of early intervention services, parental sign language skills and frequency of use, and child’s age at first exposure to ASL. These factors likely vary across a typical sample of deaf children (i.e., the student body at a school for the deaf). No research is available that examines relations among receptive and expressive skills across a typical sample of deaf children.

Expressive ASL Development

Although the sequence of spoken language development for typically hearing children is well-documented across ages (Hulit & Howard, 2002; James, 1990; Owens, 2001), the sequence of ASL acquisition is less well-documented (Enns, 2006; Enns & Herman, 2011; French, 1999). Similar to studies of receptive ASL, researchers to date have focused primarily on the expressive ASL of younger children (between 0 and 3 years of age) with deaf parents (Anderson & Reilly, 2002; Goldstein & Bebko, 2003; deBeuzeville, 2006; Morgan, 2006; Rinaldi, Castelli, Di Renzo, Gulli, & Voltterra, 2014; Schick, 2011). Children who are exposed to sign language from birth tend to have language development parallel to their typically hearing peers (Baker, 2010; Spencer & Harris, 2006; Voltterra, Iverson, & Castrataro, 2006). For example, first spoken words/signs appear around the same age (Anderson & Reilly, 2002), similar numbers of words are acquired at similar ages (Morgan & Woll, 2002), and language structures, such as the combination of two words, are acquired in the same order (Caselli, 1994).

Within ASL, sign parameters (i.e., handshape, location, and movement) are combined in various ways and with nonmanual markers (i.e., facial expressions, body shift, eye gaze) to represent different constructions. As they progress toward adult-like production, young children systematically modify all parameters (Morgan, 2008; Takkinen, 2008), such as simplification of movement (Baker et al., 2008; Takkinen, 2008) and sequential, as opposed to simultaneous, production of parameters (deBeuzeville, 2006). These modifications are resolved as children increase in age (Morgan, 2008). The DoDP from 0 to 3 years of age produce location and movement (Conlin, Mirus, Mauk, & Meier, 2000; Marentette & Mayberry, 2000; Siedlecki & Bonvillian, 1993, 1997; Singleton & Newport, 2004) more accurately than handshape (Kantor, 1980; Morgan, 2006), which was produced in adult-like fashion by DoDP at 5–7 years of age (Takkinen, 2008). They also combine sign parameters into the more complex structure of classifiers as early as 2;4 (years;months) (Lillo-Martin, 1988; Lindert, 2002; Newport, 1981; Slobin et al., 2003) and within the range of 2;5 to 4 years (Baker, van den Bogaerde, & Woll, 2008; Ellenburger & Steyaert, 1978; Lillo-Martin, 1988; Lindert, 2002; Slobin et al., 2003; Supalla, 1982), with emergence of correct classifier production between 3;0 and 3;5 (Baker et al., 2008). Classifiers are complex polymorphemic constructions within ASL “in which handshape, location, and movement represent properties of nouns, adjectives, and verbs” (Lederberg et al., 2013, p. 16). Classifiers include identification of a figure and ground (i.e., secondary object), handshapes to represent each, and movement of handshapes to demonstrate interaction.
among the objects (Aarons & Morgan, 2003; Morgan, 2006). Because classifiers are complex and used frequently in adults’ (Aarons & Morgan, 2003; Morford & MacFarlane, 2003) and children’s (Beal-Alvarez & Easterbrooks, 2013; Morgan, 2006) narratives, students’ expressive ASL was investigated within the context of classifiers in this study.

Classifier Development

Children’s use and accuracy of classifiers increases with age (deBeuzeville, 2006; Morgan, 2006; Morgan & Woll, 2007; Schick, 1990, 2006; Singleton & Newport, 2004; Supalla, 1982, 1986) with adult-like use between 9 and 13 years of age (deBeuzeville, 2006; Morgan, 2002; Morgan & Woll, 2003; Slobin et al., 2003). For example, young children produced classifiers in obligatory contexts only 30% of the time (Schick, 1990) and with sequential as opposed to adult-like simultaneous parameter production (deBeuzeville, 2006), whereas those between 3 and 5 years of age produced them around 50% of the time (Schick, 2006).

Although children produce accurate parameters within classifiers at relatively early ages, they may substitute simpler movements for more complex movements (Baker et al., 2008). Inclusion of a secondary object, or ground, is frequently omitted by children because they either lack the ability to visually represent more than one object at a time (i.e., figure and ground; Schick, 2011), the required two-handed coordination to do so (Boudreault & Mayberry, 2006; Slobin et al., 2003), or assume that the listener is already aware of the ground (Becker, 2009; deBeuzeville, 2006; Morgan, 2006). Ground inclusion increases between 5 and 8 years of age (deBeuzeville, 2006), but correct establishment of and reference to figures in space may not be mastered until 11–13 years of age (Morgan, 2002; Morgan & Woll, 2003). Although adults customarily identify the figure and ground prior to using classifiers (Aarons & Morgan, 2003; Fish, Morén, Hoffmeister, & Schick, 2003; Morgan, 2008; Schick, 2006; Wilbur, 2011), children may omit figure and ground identification (Beal-Alvarez & Easterbrooks, 2013; Becker, 2009; Morgan, 2006), although ambiguity within classifier production appears to decrease with age (Morgan, 2006).

Classifiers are frequently grouped into three types: semantic classifiers, in which the hand(s) represents a whole entity; SASSes, in which the hand(s) highlight visual characteristics of some entity; and handle, in which the hand(s) represent the handling of an object (Schembri, 2003; Schick, 2006, 2011). The acquisition, use, and mastery of these classifier types appear to vary across children based on limited data (Kantor, 1980; Schick, 1990), such that one type of classifier is not dominant in children’s development of classifier production. From 5–8 years of age, DoDP children produced semantic and SASS classifiers with 80% accuracy (Schick, 1990). The DoDP and DoHP 7 years of age with varied exposure to sign language produced classifiers in which “the hand represented all or part of the referent” (Cormier, Smith, & Sevcikova, 2013, p. 384) and those between 7 and 11 years of age produced all three types of classifiers within narrative contexts (Beal-Alvarez & Easterbrooks, 2013).

Some researchers (Evans, Zimmer, & Murray, 1994; Herzig, 2002; Mounty, 1994) have developed sequential expressive ASL checklists. However, the checklists do not include specific ages for emergence and mastery of structures within typical sign language development, likely due to children’s diverse ASL experiences. Herzig’s (2002) scale includes five skill levels, from “beginning” to “advanced” across nine areas of ASL. Each level within a category describes what the skill looks like, such as use of instrument (e.g., ZIP-UP) and locative (e.g., PENCIL-ON-DESK) classifiers at “early intermediate” and use of plural spatial classifiers (e.g., TWO-PEOPLE-WALKING) at “early advanced” stages.

Evans and colleagues (1994) checklist highlights children’s ASL production across four stages from 1;6 to 6 years of age and includes sign formation (handshapes and movement), grammar (classifiers, verb and noun modification), sentences (length, negation, questions, complex), and storytelling (spatial reference, role shift). According to Evans and colleagues’ checklist, children’s classifier productions include object classifiers at stage one (i.e., size and shape specifiers; e.g., two-handed POLE using [O] handshapes); objects with movement (e.g., [3] handshape moving forward to show a car) at stage two; verb classifiers (e.g., [V] handshape to show a man climbing up a pole) at stage
three; and verb chains (e.g., [3] handshape to show a car driving forward, up a hill, turning left, and parking) at stage four. Although this detailed sequence is helpful in understanding sequential ASL development, it is difficult to identify what deaf children with varied exposure to ASL “should” know at specific ages.

In their proposed elementary ASL Framework Overview, the California School for the Deaf at Fremont matches classifier skills to grade level, such that students in first grade should be able to use conceptually appropriate classifiers to describe people, places, and things (CSDF, 2009). In second grade, students should understand how movement and directionality affect classifier meaning, and in third grade they should be able to “manipulate classifiers for effect and purpose (locative and descriptive)” (CSDF, p. 1). Finally, in fourth grade, they should be able to manipulate classifiers for perspective and viewpoint.

Although the ASL-RST (Enns et al., 2013) is available to teachers, no expressive assessments currently exist for teacher use (see Haug, 2008, and Singleton & Supalla, 2011, for a review). Measures developed for research take 1–2 hrs to administer and 15–20 hrs to score (Hoffmeister, 1999; Supalla et al., n.d.). Because of the lack of efficient expressive ASL assessments (Singleton & Supalla, 2011), the Ozcaliskan Motion Stimuli (OMS) were used as an expressive measure in this study. The OMS are a collection of 18 animated clips in PowerPoint slideshow format that were designed for gesture studies with bilingual speakers of English and Turkish (Ozcaliskan, 2011). The OMS were used earlier to elicit classifier production by deaf adults (Beal-Alvarez & Easterbrooks, 2012) and children (Beal-Alvarez & Easterbrooks, 2012, 2013). Each animated clip shows the same figure (i.e., a man) moving in reference to various secondary objects (such as a man crawling across a rug), similar to items in the Verbs of Motion Production subtest of the Test Battery for ASL Morphology and Syntax (Supalla et al., n.d.). Although multiple options are possible in renditions of the clips, when prompted to render the animated clips in sign language, adults consistently produced semantic and SASS classifiers (Beal-Alvarez & Easterbrooks, 2012) and results were similar, although with less accuracy, for a sample of students in elementary grades (Beal-Alvarez & Easterbrooks, 2013). The adult scores were used as target performance in this study, similar to earlier research (Morgan & Woll, 2003; Rinaldi et al., 2014) as a means of comparison for students’ performance. The OMS are efficient classifier elicitation stimuli, at about 10 min for administration and 30 min for coding. Earlier studies (Beal-Alvarez & Easterbrooks, 2012, 2013) used a coding system specifically developed to document the presence or absence of classifiers in participants’ renditions, which is explained in the methods section as in what follows.

ASL Exposure and Acquisition

The available data on ASL development represents a small portion of the D/HH student population. Most students have hearing parents (Mitchell & Karchmer, 2004) and varied exposure to fluent ASL models (Schick et al., 2006; Moeller & Schick, 2006), for a variety of reasons. In general, hearing parents simply are unprepared for communication with a child who uses sign language, which requires obtaining and sharing joint attention (Harris, 2001; Lederberg & Everhart, 1998; Waxman & Spencer, 1997), appropriate responses to “mabbling,” (Baker et al., 2008), and knowledge and use of sign language lexicon, syntax, and grammar (Neidle, Kegl, MacLaughlin, Bahan, & Lee, 2000). Parental fluency in ASL directly affects children’s fluency (Lederberg & Everhart; Singleton & Newport, 2004), and amount of ASL input is a “crucial factor” in children’s language development (Baker et al., 2008, p. 5).

However, frequently this is not the case. Some students begin with a spoken language approach and transition to the use of sign language at later ages (Enns et al., 2007; Mayberry & Eichen, 1991; Musselman & Akamatsu, 1999). Their first language, a spoken form with limited access, may cause interference with acquisition of ASL (Baker et al., 2008) at native-like levels. Other students who eventually transition to the use of sign language do so as older transfers to residential schools after “a history of unsuccessful deaf education placements in public schools” (Andrews & Covell, 2006/2007, p. 466). Most children, including those with deaf parents, are exposed to multiple languages (e.g., sign language, spoken language and code-blending/mixing) when communicating with their parents.
Students who learn ASL as a first language at a delayed age typically do not acquire complex morphology and syntax at native-like levels (Mayberry & Eichen, 1991; Morford & Mayberry, 2000). Because DoDP represents the minority of D/HH students, Singleton and Supalla (2011) questioned if norms for ASL assessments should be based on only a subset of native and early signers, such as those who learn ASL from infancy from their deaf parents. In contrast, assessment of the student body at a residential school may document the typical variation found within students’ ASL skills at certain ages (Enns et al., 2007). Many residential students enter at later ages and are likely to be delayed in language skills because of a lack of input when they were young. To date, neither language samples from a school-aged population nor an efficient expressive assessment are available to efficiently document students’ language skills and use those results to direct instruction. Additionally, limited comparison results across school ages and diverse background variables prevent relative guidelines for both receptive and expressive language instruction.

Purpose

The purpose of this study was to investigate the receptive and expressive ASL skills of a residential student population who was exposed to ASL daily for communication and instruction. My research questions were: (a) How does receptive and expressive ASL develop across ages? and (b) How are receptive and expressive ASL development related?

Methods

Setting

The research site for this study was a state residential school for the deaf. Thirty-five percentage of the teaching staff was deaf. The student body consisted of 108 students in prekindergarten through high school. Many students transferred from local school systems to the residential school during middle and high school. For example, 35% of the current senior student body transferred to the residential school for repeated opportunities to participate in state assessments required for high school graduation. Students stayed on campus in dorms during the week and traveled home via bus every weekend.

Students

Ninety-eight students participated in this study, including 13 with varying exceptionalities (e.g., intellectual disability); however, their scores were excluded because their development was not typical. Therefore, this study reports results for 85 students, 6;4 (years;months) to 22;2 years, without exceptionalities. Eighteen students were day students; the rest lived in the dorms on campus during the week. About a quarter of the students were in elementary, a quarter in middle school, and half were in high school. All students used sign language for communication and school staff promoted the use of ASL in contrast to Simultaneous Communication (i.e., speaking and signing at the same time). Students had attended the residential school for a range of a few months to all of their educational years. A small number of students used hearing aids and cochlear implants. Nine students had one or two deaf parents (DoDP). Age of acquisition of sign language was not available. For purposes of this study, students were divided into three groups: 6–13 years (n = 24; M = 10;10); 14–22 years (n = 52; M = 18;1), and DoDP (n = 9; M = 12;9; range 9;2–17;10).

Adults

For comparison purposes on the OMS, I collected data from 19 deaf adults who were staff at either the residential school or a day school for the deaf in close geographical proximity. Based on self-report, all adults were identified with (a) hearing loss at age ≤3 years; (b) their home languages as children varied; (c) as children they attended various schools (i.e., day schools for the deaf, residential schools for the deaf, and their local neighborhood schools); and (d) half attended multiple school settings. All but one were college graduates and half had master’s degrees. Mean age for the adult participants was 35 years (range 22–50 years). A group of 13 adults acquired ASL between 1 and 5 years of age (M = 2.5 years), had used ASL for 20–44 years (M = 30 years), and had a mean age of 33 years. A second group of six adults acquired ASL between 12 and 18 years of age (M = 16 years), had used ASL for
14–35 years ($M = 25$ years), and had a mean age of 41 years. American Sign Language was the preferred language for 16 of the 19 participants.

Instruments

**ASL-RST.** The ASL-RST (Enns et al., 2013) was used as a measure of students’ ASL receptive skills in eight grammatical categories. These include: (a) number/distribution (e.g., TWO ROWS (BEDS)), (b) negation (e.g., [NO] SLEEP and NOT-YET HAT), (c) noun–verb distinction (e.g., DRIVING and CHAIR), (d) spatial verbs–location (e.g., TABLE BALL ON) and spatial verbs–action (e.g., TWO-PEOPLE-MEET), (e) size and shape classifiers (e.g., THIN-STRIPES-DOWN-SHIRT), (f) handle classifiers (e.g., HOLD-UMBRELLA-WALKING), (g) role shift (e.g., TAP-GIRL, GIRL-TURN-LOOK), and (h) conditionals (e.g., IF RAIN, GAME CANCEL). First, participants complete a 20-item vocabulary pretest to ensure they are familiar with the objects within the assessment items; then they watch 42 video clips and respond in a fashion similar to Schick et al. (2007).

**Ozcaliskan Motion Stimuli.** For the OMS (Ozcaliskan, 2011), students and adults watched the animated clips on a computer and signed each clip immediately afterward while videotaped. They were given the following directions: “I will show you short video clips on the computer. Then you show me how to sign them.” They were not given feedback on any items to prevent modeling of classifiers and to ensure narratives were as natural as possible (Cormier et al., 2013). Across stimuli, choices for each classifier component used were consistent, which created a closed set of responses for each. Across responses to the 18 clips, I counted total classifiers produced, accuracy of classifier parameters, and the total number of each classifier type (i.e., semantic, SASS, handle).

For the purposes of this study, classifiers that may be considered more lexicalized, such as CRAWL, were coded as classifiers by my definition, to err on the side of overidentification (Cormier et al., 2013). I calculated production accuracy of each parameter by dividing the participant’s number of correct parameter productions by the total number of overall productions. For example, if the participant produced 10 figure handshapes and nine of them were accurate, his figure handshape score was 90%. This coding scheme was based on earlier results with adults (Beal-Alvarez & Easterbrook, 2012) and children (Beal-Alvarez & Easterbooks, 2013). Interobserver agreement for the OMS data was conducted using blank versions of the coding sheets completed by the author, who has an Advanced Plus rating on the Sign Language Proficiency Interview (SLPI;
Table 1: Classifier parameters and types

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Classifier parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Figure identification</td>
<td>Character who participates in action or identifies object described or handled</td>
<td>BOY, MAN, PERSON</td>
</tr>
<tr>
<td>Ground identification</td>
<td>Secondary object described or handled</td>
<td>HOUSE, R-U-G, BEAM</td>
</tr>
<tr>
<td><strong>Types</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SASSa</td>
<td>Hand(s) represent a whole entity</td>
<td>PERSON</td>
</tr>
<tr>
<td>Handle</td>
<td>Hand(s) highlight visual characteristics of some entity</td>
<td>R-O-P-E</td>
</tr>
<tr>
<td>Hand(s) represent the handling of an object</td>
<td>Hand(s) used to show action of character or to describe or handle object.</td>
<td>CLIMB-ROPE</td>
</tr>
</tbody>
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Results

For movement, 90% of students scored 40 or more on the 42-item ASL-RST test, students in grades 6-13 scored 37 or more on the 32-item ASL-RST test, and students in grades 14-22 scored 32 or more on the 31-item ASL-RST test. The first research question was: How does receptive and expressive ASL develop across ages? Using raw scores for the 42-item ASL-RST test, students scored from 11 to 38; no student scored at ceiling (see Figure 1). Based on their standard scores, all students aged 6-13 years fell within the average range for their age (i.e., ±1 SD below or above the mean; Enns et al., 2013). Youngest students scored the lowest and had greater score variation than older students. Scores appeared to jump by about five correct items between younger and older elementary students and then scores plateaued around a raw score of 31 (out of 42; range = 25–38) across students 13-22 years of age (see Table 2). This is equivalent to accurately identifying about 75% of the assessment items. DoDP and older students scored similarly (30-38) with slight increases in DoDP scores with slight increases in DoDP scores. Interobserver agreement was 96% for classifier production, 99% for figure identification, 94% for ground identification, 98% for figure handshape, 94% for ground handshape, and 97% for movement.

In addition, the younger students had twice the amount of scatter in their scores as the older two groups. The difference between the older and DoDP groups was significant, with older students scoring higher in all categories. The difference between the younger and older groups was significant, with the younger groups scoring lower. A second trained rater, who has an Intermediate SLPI rating. To select 15% of the data sheets, a list of random numbers between 1 and 85 (students) and 1 and 19 (adults) was generated using the 'RANDBETWEEN' function in Microsoft Excel. Interobserver agreement was 96% for classifier production, 99% for figure identification, 94% for ground identification, 98% for figure handshape, 94% for ground handshape, and 97% for movement.

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I conducted a one-way between participants ANOVA to compare scores by age and parental hearing status across three groups (i.e., 6-13, 14-22, DoDP) and nine grammatical categories to investigate the effects of these variables on overall raw scores for the three groups. F(2, 82) = 10.35, p < .000. Posthoc analyses (Tukey) showed a significant difference for mean overall score between the younger and older groups (LSD = 11.8), with the younger group scoring lower than the older groups. There was a significant effect of group on ASL-RST scores, with the DoDP group scoring lower than the other two groups (LSD = 2.5, p < .000). Younger students scored lower than older students, with younger students scoring 11.8 points lower than older students on the ASL-RST. Based on their standard scores, all students aged 6-13 years fell within the average range for their age (i.e., ±1 SD below or above the mean; Enns et al., 2013). The first research question was: How does receptive and expressive ASL develop across ages? Using raw scores for the 42-item ASL-RST test, students scored from 11 to 38; no student scored at ceiling (see Figure 1). Based on their standard scores, all students aged 6-13 years fell within the average range for their age (i.e., ±1 SD below or above the mean; Enns et al., 2013). Youngest students scored the lowest and had greater score variation than older students. Scores appeared to jump by about five correct items between younger and older elementary students and then scores plateaued around a raw score of 31 (out of 42; range = 25–38) across students 13-22 years of age (see Table 2). This is equivalent to accurately identifying about 75% of the assessment items. DoDP and older students scored similarly (30-38) with slight increases in DoDP scores with slight increases in DoDP scores. Interobserver agreement was 96% for classifier production, 99% for figure identification, 94% for ground identification, 98% for figure handshape, 94% for ground handshape, and 97% for movement.

In addition, the younger students had twice the amount of scatter in their scores as the older two groups. The difference between the older and DoDP groups was significant, with older students scoring higher in all categories. The difference between the younger and older groups was significant, with the younger groups scoring lower. A second trained rater, who has an Intermediate SLPI rating. To select 15% of the data sheets, a list of random numbers between 1 and 85 (students) and 1 and 19 (adults) was generated using the 'RANDBETWEEN' function in Microsoft Excel. Interobserver agreement was 96% for classifier production, 99% for figure identification, 94% for ground identification, 98% for figure handshape, 94% for ground handshape, and 97% for movement.

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of the nine grammatical categories had significant effects for group (mean raw score): number-distribution $F(2, 82)=4.01, p = .021$, negation $F(2, 82) = 9.82, p < .000$, location $F(2, 82) = 8.23, p = .001$, action $F(2, 82) = 5.99, p = .004$, SASS classifiers $F(2, 82) = 7.18, p = .001$, and handle classifiers $F(2, 82) = 3.70, p = .029$. There was no significant effect of group for noun–verb $F(2, 82) = 2.63, p = .078$, role shift $F(2, 82) = .44, p = .647$, or conditionals $F(2, 82) = 1.62, p = .205$.

Across five categories (excluding SASS classifiers) there were no significant differences between mean scores for the older and DoDP groups. However, the younger group scored significantly lower than both groups in most cases. For number-distribution, the younger students scored significantly lower ($M = 3.9, SD = 1.3$) than the older students ($M = 4.8, SD = 1.2; p = .016$), but there was no significant difference when compared with the DoDP ($M = 4.3, SD = 1.3; p = .672$). For negation,
younger students scored significantly lower ($M = 5.2$, $SD = 2.4$) than older students ($M = 6.6$, $SD = 1.2$; $p = .002$) and DoDP ($M = 7.7$, $SD = 1.1$, $p = .001$). For location, the younger students scored significantly lower ($M = 4.6$, $SD = 1.6$) than the older ($M = 5.7$, $SD = 1.1$; $p = .002$) and DoDP ($M = 6.2$, $SD = 0.98$; $p = .004$) groups. For action, the younger scored significantly lower ($M = 5.5$, $SD = 1.7$) than the older ($M = 6.4$, $SD = 1.2$; $p = .011$) and DoDP ($M = 7.0$, $SD = 1.0$; $p = .013$) students. Finally, for handle classifiers, the younger ($M = 1.9$, $SD = 0.93$) significantly differed from the older ($M = 2.4$, $SD = 0.69$; $p = .028$) students but not DoDP ($M = 2.4$, $SD = 0.53$). In contrast to these five categories, there was no significant difference between means of younger ($M = 2.3$, $SD = 1.2$) and older ($M = 2.7$, $SD = 0.91$; $p = .385$) students for SASS classifiers, but the DoDP ($M = 3.8$, $SD = 0.44$) scored significantly higher than both age groups ($p = .001$; $p = .006$).

Mean item score across grammatical categories for students within the test’s intended age range are presented in Table 3. Generally, across categories, older students outperformed younger students and DoDP outperformed their same-aged DoHP peers and with less variation. Across ages, students ranged from floor to ceiling for handle classifiers, role shift, and conditionals. Trajectories created with percentage of items correct across grammatical categories revealed general increases across ages, with some categories (i.e., noun–verb) higher across ages and other categories (e.g., negation, role shift) lower across ages (Figure 2). Some categories (e.g., SASS classifiers) varied greatly across ages. For example, SASS classifiers was one of the lowest categories for the younger students (i.e., 6–8 and 10) and one of the highest for older students (i.e., 9, 11–13). In contrast, handle classifiers was a higher category for the younger students (i.e., 7–9) and one of the lower categories for older students (i.e., 10–13).

Finally, I conducted correlations between age and overall score, and age and grammatical categories. Correlations between age and overall ASL-RST scores were strong and significant across all students ($r = .52$), younger students ($r = .79$), and DoDP ($r = .76$), but insignificant for the older students ($r = .16$). The youngest group had significant correlations between age and all ASL-RST categories except handle classifiers, five of which were strong and three were moderate (see Table 4). The DoDP had three strong and two moderate correlations; none were statistically significant. The older group had only one moderate and significant correlation (i.e., noun–verb).

The ASL-RST was designed so that item difficulty increases with item number (Enns & Herman, 2011). More than half of the students in the present sample missed 11 of the last 12 items, or those that are more complex. These items were spread across six of the grammatical categories.

OMS

The OMS elicited classifier productions from all adults and students. Expressively, the adults produced a mean
Table 3  ASL-RST mean and standard deviation by age and parental hearing status for number of categorical items correct

<table>
<thead>
<tr>
<th>Category (no. of items)</th>
<th>6^a</th>
<th>7^a</th>
<th>8^a</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12^a</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DoHP</td>
<td>DoHP</td>
<td>DoHP</td>
<td>DoDP</td>
<td>DoHP</td>
<td>DoDP</td>
<td>DoHP</td>
<td>DoDP</td>
</tr>
<tr>
<td>Number-distribution (7)</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Negation (9)</td>
<td>2.0 (1.4)</td>
<td>2.7 (1.2)</td>
<td>3.0</td>
<td>3.3 (0.6)</td>
<td>3.5 (2.1)</td>
<td>3.0 (0)</td>
<td>3.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Noun–verb (4)</td>
<td>2.5 (0.7)</td>
<td>2.0 (1.0)</td>
<td>2.0</td>
<td>2.3 (0.6)</td>
<td>3.0 (0)</td>
<td>2.5 (0.7)</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Location (8)</td>
<td>3.0 (1.4)</td>
<td>3.7 (0.6)</td>
<td>3.0</td>
<td>4.3 (2.5)</td>
<td>6.0 (0)</td>
<td>5.0 (1.4)</td>
<td>5.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Action (8)</td>
<td>4.0 (1.4)</td>
<td>4.0 (2.0)</td>
<td>2.0</td>
<td>6.0 (1.0)</td>
<td>7.5 (0.7)</td>
<td>3.5 (0.7)</td>
<td>5.0</td>
<td>7.0</td>
</tr>
<tr>
<td>SASS (4)</td>
<td>1.5 (2.1)</td>
<td>1.3 (11.5)</td>
<td>1.5</td>
<td>2.3 (0.6)</td>
<td>4.0 (0)</td>
<td>0.5 (0.7)</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Handle (3)</td>
<td>1.0 (1.4)</td>
<td>1.7 (0.6)</td>
<td>1.0</td>
<td>2.3 (0.6)</td>
<td>2.5 (0.7)</td>
<td>1.5 (0.7)</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Role shift (3)</td>
<td>1.5 (0.7)</td>
<td>0.3 (0.6)</td>
<td>0</td>
<td>1.3 (1.5)</td>
<td>1.0 (0)</td>
<td>1.5 (0.7)</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Conditionals (2)</td>
<td>1.5 (0.7)</td>
<td>1.0 (0.0)</td>
<td>1.0</td>
<td>1.0 (1.0)</td>
<td>1.5 (0.7)</td>
<td>1.0 (0)</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Note. ASL-RST = American Sign Language Receptive Skills Test.

^aNo DoDP in age group.
^bDoHP = deaf of hearing parent.
^cDoDP = deaf of deaf parent.
^dOnly one participant; therefore no standard deviation.
of 28 classifiers (range 19–40) across the 18 clips. They scored at ceiling for accuracy in handshape and movement production; scores were lower for figure identification ($M = 72\%$, $SD = 27\%$) and ground identification ($M = 86\%$, $SD = 13\%$) (see Table 5). There was no difference in scores across OMS parameters for adults who acquired ASL earlier as opposed to later.

Based on mean scores by age, younger students (i.e., 6–14 years) produced fewer classifiers ($M = 12.3–14.6$; range 5–21) than older students (i.e., 15–22 years; $M = 17.5–21.2$, range 6–31) and DoDP (i.e., 9–17 years; $M = 19.8$, range 8–31), although individual student performance varied. For example, a younger (6;8) DoHP student produced 18 classifiers; two 13-year-old male DoDP produced 28 and 8 classifiers, respectively. Scores for all classifier parameters gradually increased across ages but remained below scores of adults. The DoDP ($M = 12.7$) performed similarly to the older students ($M = 18.0$). Use of semantic and SASS classifiers also increased across age, whereas use of handle classifiers was similar across ages, as only two clips elicited this type of classifier. Variation within groups tended to decrease with age, although variation in the number of classifiers produced increased slightly across ages, as determined by the mean trend line across scores.

To investigate if age differences were significant, I calculated a one-way MANOVA, which revealed a significant multivariate main effect for age, Wilks’ $\lambda = .449$, $F(18, 186) = 5.09$, $p < .001$. Given the significance of the overall test, I examined univariate main effects, which revealed significant age effects at the $p < .05$ level for overall score, total classifiers, semantic classifiers, SASSes, figure identification, and ground identification (Tukey HSD; see Table 5). Significant pairwise differences for age were obtained across all age groups for all classifier parameters except figure identification and SASSes. For these two categories, there was a significant effect of age between the adults and all students, but not between the student groups. The effect of age on ground handshape approached significance for the younger group when compared with adults ($p = .051$) and older peers ($p = .053$). In addition, significant moderate correlations existed between student age and overall score ($r = .33$, $p < .005$), total classifiers produced ($r = .40$, $p < .001$), ground identification ($r = .46$, $p < .001$), ground handshape ($r = .30$, $p < .005$), and semantic classifier production ($r = .37$, $p < .001$). In sum, classifier productions increased in accuracy with age but students did not reach adult-like performance.

### Table 4 Correlations by age and grammatical category for raw scores on the ASL-RST

| Overall score | .52* | .79* | .16 | .76** |
| Number distribution | .44* | .72* | .09 | .60 |
| Negation | .46* | .75* | .20 | .58 |
| Noun-verb | .33* | .67* | .37* | .26 |
| Spatial verbs: location | .39* | .47** | .08 | .61 |
| Spatial verbs: action | .35* | .63* | .01 | .32 |
| SASS | .17 | .58* | .08 | .22 |
| Handling | .29* | .30 | .01 | .35 |
| Role shift | .18 | .47** | .03 | .11 |
| Conditionals | .21 | .45** | .01 | .07 |

Note. ASL-RST = American Sign Language Receptive Skills Test; DoDP = deaf of deaf parent; SASS = size-and-shape-specifier.

*Approached significance at $p = .52$.

*p < .01.

**p < .05.

ASL-RST and OMS Correlations

The next research question was: How are receptive and expressive ASL development related? Of a possible 100 correlations among receptive categories and expressive parameters, there were 28 significant correlations. The ASL-RST overall score correlated with total classifiers and most OMS parameters (see Table 6). Receptively, negation, location, action, and SASS classifiers correlated with the most OMS parameters. Expressively, total classifiers and SASSes correlated with most receptive categories. In summary, students’ receptive and expressive skills increased with age, but no students...
Table 5  Means and standard deviations across ages on the OMS

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>n</th>
<th>Total CL</th>
<th>Figure ID</th>
<th>Ground ID</th>
<th>Figure HS</th>
<th>Ground HS</th>
<th>Mvmt</th>
<th>Handle</th>
<th>Sem</th>
<th>SASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6–7</td>
<td>5</td>
<td>13.6 (5.7)</td>
<td>0</td>
<td>30 (30)</td>
<td>99 (2)</td>
<td>73 (44)</td>
<td>91 (13)</td>
<td>1.0 (1.0)</td>
<td>10.6 (2.9)</td>
<td>2.0 (2.5)</td>
</tr>
<tr>
<td>8–9</td>
<td>6</td>
<td>13.7 (5.8)</td>
<td>20 (25)</td>
<td>42 (39)</td>
<td>86 (29)</td>
<td>80 (40)</td>
<td>89 (25)</td>
<td>1.3 (1.0)</td>
<td>9.5 (4.5)</td>
<td>2.8 (2.8)</td>
</tr>
<tr>
<td>10–11</td>
<td>5</td>
<td>14.6 (4.5)</td>
<td>33 (33)</td>
<td>25 (22)</td>
<td>96 (6)</td>
<td>98 (4)</td>
<td>98 (3)</td>
<td>1.6 (0.5)</td>
<td>10.8 (4.0)</td>
<td>2.2 (1.5)</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>14.7 (3.0)</td>
<td>34 (32)</td>
<td>47 (28)</td>
<td>100 (0)</td>
<td>100 (0)</td>
<td>94 (6)</td>
<td>2.0 (0)</td>
<td>8.8 (3.1)</td>
<td>3.8 (1.0)</td>
</tr>
<tr>
<td>13</td>
<td>8</td>
<td>13.0 (8.7)</td>
<td>36 (46)</td>
<td>53 (31)</td>
<td>99 (2)</td>
<td>86 (35)</td>
<td>95 (6)</td>
<td>1.3 (0.9)</td>
<td>8.8 (5.7)</td>
<td>3.0 (3.1)</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>12.3 (7.0)</td>
<td>29 (39)</td>
<td>42 (41)</td>
<td>99 (2)</td>
<td>94 (7)</td>
<td>92 (8)</td>
<td>1.2 (1.1)</td>
<td>7.8 (6.6)</td>
<td>3.0 (0.7)</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>17.5 (4.2)</td>
<td>53 (45)</td>
<td>68 (22)</td>
<td>99 (2)</td>
<td>93 (7)</td>
<td>97 (6)</td>
<td>1.3 (1.0)</td>
<td>12.3 (4.7)</td>
<td>3.8 (3.2)</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>20.2 (2.8)</td>
<td>20 (34)</td>
<td>62 (35)</td>
<td>98 (4)</td>
<td>96 (9)</td>
<td>99 (2)</td>
<td>1.4 (0.9)</td>
<td>15.8 (1.9)</td>
<td>3.0 (2.4)</td>
</tr>
<tr>
<td>17</td>
<td>11</td>
<td>19.6 (7.4)</td>
<td>33 (37)</td>
<td>64 (28)</td>
<td>100 (0)</td>
<td>96 (4)</td>
<td>96 (6)</td>
<td>1.1 (0.9)</td>
<td>13.9 (5.4)</td>
<td>4.5 (3.4)</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td>17.8 (4.8)</td>
<td>49 (36)</td>
<td>71 (19)</td>
<td>99 (2)</td>
<td>97 (5)</td>
<td>95 (5)</td>
<td>1.4 (0.9)</td>
<td>12.4 (3.5)</td>
<td>3.8 (2.5)</td>
</tr>
<tr>
<td>19</td>
<td>10</td>
<td>21.5 (10.2)</td>
<td>44 (32)</td>
<td>76 (23)</td>
<td>100 (0)</td>
<td>99 (3)</td>
<td>93 (15)</td>
<td>1.8 (0.6)</td>
<td>14.2 (7.9)</td>
<td>4.8 (2.7)</td>
</tr>
<tr>
<td>20–22</td>
<td>9</td>
<td>21.2 (4.7)</td>
<td>30 (36)</td>
<td>66 (12)</td>
<td>99 (3)</td>
<td>95 (7)</td>
<td>96 (7)</td>
<td>2.1 (2.7)</td>
<td>15.7 (3.3)</td>
<td>3.8 (2.4)</td>
</tr>
<tr>
<td>DoDP</td>
<td>6</td>
<td>19.8 (7.6)</td>
<td>33.3 (37.5)</td>
<td>70.8 (21.4)</td>
<td>97.3 (4.2)</td>
<td>99.5 (1.5)</td>
<td>95.7 (5.3)</td>
<td>1.3 (0.9)</td>
<td>12.9 (5.5)</td>
<td>5.6 (3.2)</td>
</tr>
<tr>
<td>Adults</td>
<td>19</td>
<td>27.8 (5.1)</td>
<td>72.2 (27.0)</td>
<td>85.8 (13.2)</td>
<td>100 (0)</td>
<td>99.1 (1.6)</td>
<td>99.3 (0.03)</td>
<td>1.8 (0.9)</td>
<td>19.2 (3.7)</td>
<td>7.1 (4.0)</td>
</tr>
</tbody>
</table>

Note. CL = classifier; HS = handshape; Mvmt = movement; OMS = Ozcaliskan Motion Stimsuli; Sem = semantic; SASS = size-and-shape-specifier.

Discussion

This study investigated students' receptive and expressive ASL skills with a school-wide sample of students exposed to ASL for daily instruction. Receptively, younger students scored significantly lower than and with twice the variability of older students and DoDP, who scored similarly. Younger, varied student performance may reflect typical variability across these ages and/or a lack of exposure to sign language, whereas higher and less variable performance by some older students and DoDP may reflect longer ASL exposure times and/or younger ages of acquisition, two factors that affect language development (Mayberry & Eichen, 1991; Morford & Mayberry, 2000). Based on mean scores across ages, students aged 6–13 years in the present sample scored lower than their same age native or near-native peers in the standardization sample (Enns et al., 2013), except for those in the 11–12 year range. Unlike Allen and Enns’ results for younger children who ranged 10–30% across grammatical categories (Allen & Enns, 6–to 8-year-olds in this study ranged from 10% to 65%, and 9–13-year-olds from 30% to 100%). Combining present trajectory results with Allen’s data for younger children, there is not a clear ordering of category trajectories over time across the present sample. There is little difference across ages in the intended age range, there were strong correlations between performance and age for students who ranged 10–30% across grammatical categories (Allen & Enns). 6–to 8-year-olds in this study ranged from 10% to 65%, and 9–13-year-olds from 30% to 100%.

The DoDP had similar or slightly higher scores when compared with Enns and colleagues’ scores. In addition, there were strong correlations between performance and age for students who ranged 10–30% across grammatical categories (Allen & Enns). 6–to 8-year-olds in this study ranged from 10% to 65%, and 9–13-year-olds from 30% to 100%.

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appear in the bottom half (number-distribution, negation (although highest for youngest children), and role shift); and (c) some categorical trajectories vary across ages (SASSes, handle, and conditionals). Role shift, handle classifiers, and conditionals appear to be more complex areas based on present and prior performance (Allen & Enns, 2013; Enns & Herman, 2011). Across these three categories, students performed from floor to ceiling; DoDP performed no differently than DoHP; and these categories had the lowest correlations with age. In contrast, DoDP scored higher than DoHP across ages for SASSes. One might speculate that deaf parents, who more often are native signers, embed more classifiers into their sign language, as reported during spontaneous narratives (Morford & MacFarlane, 2003; Morgan & Woll, 2003), than hearing parents, who frequently are not native signers. However, one must keep in mind two limitations: These four categories have fewer items (2–4), a limitation noted by Enns and colleagues (2013); and the present sample is limited the number of students per year of age. In contrast, DoDP scored higher than DoHP across ages for SASSes. One might speculate that deaf parents, who more often are native signers, embed more classifiers into their sign language, as reported during spontaneous narratives (Morford & MacFarlane, 2003). Older students outsouced younger students on the ASL-RST, but their mean scores remained consistent across ages.  

### Table 6  Correlations between percentage scores for ASL-RST grammatical categories and parameters of the OMS across all students

<table>
<thead>
<tr>
<th>ASL-RST categories (receptive)</th>
<th>Total CL</th>
<th>Figure ID</th>
<th>Figure HS</th>
<th>Ground ID</th>
<th>Ground HS</th>
<th>Mvmt</th>
<th>Semantic CL</th>
<th>SASS CL</th>
<th>Handle CL</th>
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<td>.083</td>
<td>.13</td>
<td>.01</td>
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<td>.37*</td>
<td>.40*</td>
<td>.18</td>
<td>.29</td>
<td>.34**</td>
<td>.0017</td>
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<tr>
<td>Noun−verb</td>
<td>.32**</td>
<td>.25</td>
<td>.080</td>
<td>.21</td>
<td>.01</td>
<td>.10</td>
<td>.23</td>
<td>.32**</td>
<td>.12</td>
</tr>
<tr>
<td>Spatial verbs: location</td>
<td>.30**</td>
<td>.26</td>
<td>.15</td>
<td>.29</td>
<td>.33**</td>
<td>.18</td>
<td>.25</td>
<td>.28</td>
<td>.083</td>
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<tr>
<td>Spatial verbs: action</td>
<td>.35**</td>
<td>.17</td>
<td>.23</td>
<td>.29</td>
<td>.31**</td>
<td>.25</td>
<td>.41*</td>
<td>.10</td>
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<td>.33*</td>
<td>.21</td>
<td>.30**</td>
<td>.27</td>
<td>.24</td>
<td>.37*</td>
<td>.096</td>
<td></td>
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<td>.058</td>
<td>.0093</td>
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<td>.15</td>
<td>.15</td>
<td>.37*</td>
<td>.14</td>
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<td>.069</td>
<td>.032</td>
<td>.09</td>
<td>.23</td>
<td>.15</td>
<td>.06</td>
<td>.11</td>
<td>.090</td>
</tr>
<tr>
<td>Conditionals</td>
<td>.36*</td>
<td>.022</td>
<td>.070</td>
<td>.00</td>
<td>.15</td>
<td>.09</td>
<td>.31**</td>
<td>.29</td>
<td>.034</td>
</tr>
<tr>
<td>Overall score</td>
<td>.45*</td>
<td>.34*</td>
<td>.22</td>
<td>.44*</td>
<td>.41*</td>
<td>.26</td>
<td>.35*</td>
<td>.45*</td>
<td>.10</td>
</tr>
</tbody>
</table>

Note. ASL-RST = American Sign Language Receptive Skills Test; CL = classifiers; Mvmt = movement; OMS = Ozcaliskan Motion Stimuli; SASS = size-and-shape-specifier.

*p < .001.

**p < .005.

***p < .01.
across ages, at about 75% accuracy on a test with an intended ceiling at age of 13 years. There were no correlations between age and grammatical category (except noun–verb), suggesting no age-related developmental patterns in the older sample as a whole. One might speculate that many of these students were not exposed to fluent ASL until later ages, as supported by the significant increase in student body at middle and high school ages, as students transferred from local schools to the residential school. Some of these students likely switched from a spoken mode of communication at earlier ages to a signed mode at later ages, similar to earlier findings (Enns et al., 2007; Musselman & Akamatsu, 1999). Difficulty in accessing ASL, specifically due to later ASL acquisition, appears to affect processing, and therefore comprehension, of ASL grammatical structure, semantics, and sentence meaning (Baker et al., 2008; Mayberry & Eichen, 1991). This lack of access effect “reverberates throughout the processing of language structure,” meaning that it affects all levels of language (Mayberry & Eichen, 1991, p. 507). Mayberry and Eichen (1991) reported that as students’ age of acquisition of ASL increased, the proportion of ASL they understood declined. Variability in access to spoken English as a first language, prior to ASL acquisition, is an additional factor that appears to affect degree of ASL acquisition (Mayberry, 1993).

These factors probably influenced overall and grammatical scores for older students in the current sample. Perhaps, these students are beyond the critical period of language development (Mayberry, 1993; Mayberry & Lock, 2003; Morford & Mayberry, 2000; Newport, 1990; Newport, Bavelier, & Neville, 2001), meaning that they will not achieve native-like signing skills, yet are still in the process of learning ASL (Mayberry; Mayberry & Eichen, 1991; Mayberry & Lock, 2003). Students who learn ASL at later ages may need multiple years of fluent exposure prior to comprehension of more complex categories. For example, Reilly, McIntire, and Bellugi (1990) reported that conditionals were not understood by DoDP until around 5 years of age, meaning after 5 years of exposure to fluent signers. Some categories, such as role shift and conditionals, appear more complex (Enns & Herman, 2011; Reilly et al., 1990) and may require more time for acquisition. Similar to language development for typically hearing children (Gass & Selinker, 2008), and some deaf children (Rinaldi et al., 2014), deaf students may require a receptive foundation of other developmentally sequenced grammatical categories, such as negation, location, and action, which had many correlations among receptive categories and which may develop simultaneously and prior to more complex categories.

Although these older students represent a portion of the deaf population, the lack of background information on age of acquisition of ASL (and possibly spoken English) affects any generalization of these students’ skills as target performance for similar older students on this measure; however, future investigations that document these factors might yield more information on ASL comprehension at later ages.

Educators must consider multiple factors related to students’ comprehension when delivering instruction in a language that may not be fully accessible to a student, including ASL. They might begin with assessment of students’ ASL comprehension with the ASL-RST, which appears to be a sensitive measure when applied to students with diverse ASL experiences based on current and earlier results (Allen & Enns, 2013). With assessment results, educators might compare their students’ scores to this sample of same-aged peers and documented developmental trajectories to direct instruction for their students. Then, they can focus on developing student comprehension of more readily acquired language categories as a scaffold for complex grammatical categories (Vygotsky, 1978). For instance, teachers might provide models of ASL stories and frequent narrative opportunities for students to practice these ASL categories (Beal-Alvarez & Easterbrooks, 2013; Beal-Alvarez & Huston, 2014; Golos, 2010). In this study, students and adults used classifiers, similar to earlier findings (Beal-Alvarez & Easterbrooks, 2012, 2013; Morgan, 2006; Cormier et al., 2013) and classifier production developed across age, such that older participants used classifiers more frequently, accurately, and in more complex ways. This is similar to language development for typically hearing students; however, most hearing students use language fluently before the start of formal education (Hulit & Howard, 2002). Adults and students accurately produced parameters; however, frequency and complexity of
classifiers (e.g., identification of figure and ground, use of SASS classifiers to represent the ground) increased across age (it is possible that some adults had exposure to courses on ASL structure within their teacher training programs, thereby affecting their performance on the OMS). Students sometimes simplified movement by omission of the manner portion of movement, such as DOWNWARD in place of SOMERSAULT. This finding is similar to DoDP who substituted simpler movements for more complex movements around 2 to 2.5 (Baker et al., 2008). Some older students used multiple handshapes to represent an object (e.g., [V legs] and [vertical index] to represent a person), similar to Kantor’s (1980) findings for younger DoDP children.

Adults identified the figure and ground more frequently than students; however, not consistently, even when SASS classifiers were used to represent the ground, in contrast to earlier reports (Fish et al., 2003; Schick, 2006; Wilbur, 2011). Students frequently omitted figure and ground identification, similar to earlier findings for DoDP peers (Becker, 2009), although ground identification increased with age, similar to Morgan’s findings (2006). Shared knowledge of the stimuli (Schick, 2006) via shared viewing may have affected figure and ground identification. In Becker’s study, students omitted identification of a figure upon its introduction in retells of a picture story; however, they asked story-related questions of a Deaf adult prior to retelling the story, resulting in shared knowledge of the story. In this study, during use of SASS classifiers, some adults omitted identification of the object (e.g., RUG, TRASH-CAN).

Rinaldi and colleagues (2014) reported that young children (mean age = 3 years) more accurately produced predicates than nominals, proposing that the visual nature of sign language makes “action and motion more salient,” and further suggested that deaf parents may index objects in the immediate environment in lieu of using nominals (p. 13). Perhaps some participants in this sample were more accustomed to production of predicates, namely classifiers, to represent the action events, than to use of nominals for figure and ground identification. Some may have assumed object identification was explicit without an additional label, especially in the presence of shared viewing. Future investigations should eliminate shared viewing of the stimuli by the researcher to investigate the effects on figure and ground identification and the use of SASS classifiers to represent the ground. Students’ omission of SASS classifiers may be a result of their developing ability to simultaneously represent and demonstrate interaction of more than one figure in space (Schick, 2011), similar to findings for students 13 years of age and younger (Morgan, 2002; Morgan & Woll, 2003; Schick, 1990; Supalla, 1982). In lieu of classifiers, some students used lexicalized signs (i.e., BOY RUN), a strategy never implemented by the adults.

Unlike students, adults frequently alternated between observer perspective, in which they used a semantic classifier to represent the figure (e.g., [V legs] [upward], for CLIMB-TREE) and participant perspective, in which they became the participant and used a handle classifier (e.g., [S] [S] [alternate + upward] for CLIMB-ROPE), similar to other adults (Aarons & Morgan, 2003; Engberg-Pedersen, 2003; Morgan, 2006; Morgan & Woll, 2003). Perspective shifting resulted in a higher number of semantic classifier productions (although adults did not repeat the SASS classifier after introduction). However, in picture book tasks with deaf adults, individuals varied in how they used perspective shifts (Morgan, 1999; Engberg-Pedersen, 2003). Perspective shift rarely was used by students in this study, despite CSDF’s (2009) suggestion that students should be able to manipulate classifiers for perspective and viewpoint around fourth grade, an age 85% of the present sample was beyond. Perhaps, perspective shift is a complex skill that requires integration of spatial skills (Boudreault & Mayberry, 2006; Slobin et al., 2003), and theory of mind (Schick et al., 2007). Morgan (2006) reported that children develop the ability to consider other perspectives through the school-aged years. Children who are D/HH and frequently have language delays may not understand the perspectives of others until adolescence (Schick et al., 2007). Similarly, students scored lower for comprehension of role shift between two figures in the ASL-RST clips. One might speculate that understanding and using alternation among perspectives is related to understanding that another perspective exists (i.e., Theory of Mind), which occurs in typically hearing children throughout childhood (Morgan, 2006) and
into adolescence for some deaf children (Schick et al., 2007).

The difference in performance between older students and adults leads to the question, what happens in language development between high school and completion of a college degree that appears to expand adults’ use of classifiers and perspective shift? All adults used classifiers accurately, regardless of the age at which they acquired ASL. These adults are representative of the ASL input students in the present sample receive, as they are teachers and staff within the residential school and a day school nearby. Based on earlier results, those who acquired ASL at ≥12 years might be expected to comprehend and produce ASL features at less than native-like proficiency (Mayberry & Eichen, 1991; Newport, 1984, 1988, 1990). However, for the OMS, there was no difference in performance for age of acquisition or years of ASL use for adults. Cormier and colleagues (2013) reported a strong relation between amount of British Sign Language exposure and use of classifiers by adults and children, and adults used significantly more classifiers than children. In this study, students had 0 (new students) to 19 years of ASL exposure, as compared to the adults’ 14–44 years of ASL use.

Environmental factors, such as college classes and related content, communication partners (e.g., various interpreters and Deaf friends), and conversational contexts likely differ between students in a residential school and adults who are college graduates. Although this sample of adults may not be typical of the deaf adult population, they are well-educated and therefore language models for students. Future investigations might collect more detailed information from adults to address differences in sign language experiences in high school and beyond, such as various contexts (e.g., narrative), communication partners, and participation in Deaf community activities. In addition, information on students’ and their parents’ age of ASL acquisition, level of ASL fluency, and frequency of ASL use may parse out differences in students’ ASL skills.

The coding system used for the OMS had high coding reliability across parameters. The stimuli frequently elicited the same productions from adults and students; students’ productions were less frequent and less complex. Each coding decision had a yes/no answer or label with a closed set of options (e.g., boy, man, person for figure identification; beam, cat, house, rug, trash can, tree for ground). Based on current reliability results of two non-native but proficient ASL signers, teachers might use these stimuli (contact Seyda Özçalışkan at Georgia State University) or other similar stimuli to assess their students’ classifier production skills and other ASL features (see Easterbrooks & Huston, 2008).

Across a sample of students diverse in language experiences, several patterns were observed, including correlations between overall scores and among components, suggesting that the paired measures captured a well-rounded, although certainly not complete, snapshot of students’ overall ASL skills. First, the total number of classifiers students produced correlated with most receptive categories, suggesting that those students with better language comprehension have increased classifier production and vice-versa. Secondly, although figure handshape did not correlate with any receptive measures, ground handshape correlated with comprehension of negation, location, and overall receptive score. Handshape is a primary element of signs that is mastered by DoDP at young ages (i.e., 5–7 years; Täkkinen, 2008), including within classifier productions (Kantor, 1980). Figure handshape was used accurately across students and ages in this sample. In contrast, ground handshapes represented secondary objects, which requires the more complex skills of establishing two objects in space, describing the visual characteristics and placement of objects, and navigating between handshapes associated with each object (Boudreault & Mayberry, 2006; Slobin et al., 2003). In this study, ground handshapes were used with SASS classifiers, such as using a SASS classifier to outline a beam, and within semantic classifiers, such as using a horizontal index to maintain the beam, whereas the figure flips over it. Student use of SASS classifiers in this study was similar to findings for DoDP 5–9 years of age (Schick, 1990; Beal-Alvarez & Easterbrooks, 2013) and DoHP 7–11 years of age (Beal-Alvarez & Easterbrooks, 2013). Student use of SASS classifiers increased across ages in this study and correlated with comprehension of location and SASS classifiers, among four other receptive categories. However, SASS production remained about half that of the deaf adults, suggesting a long developmental time frame...
before students approach adult-like performance for SASS classifiers on the OMS.

Naming the figure and ground within one’s classifiers correlated with comprehension of SASS classifiers. Interestingly, on the ASL-RST, the objects described with SASS classifiers were not explicitly named (i.e., labeled by lexical sign or fingerspelling). All four ASL-RST SASS classifiers were produced on the body, such as [O] handshapes on the head to outline pigtails and [4] handshapes down one’s chest to outline stripes on a shirt, and did not require explicit identification of the object because the objects (i.e., a girl; a shirt) were the same across response options for particular clips. In contrast, the OMS elicited SASS classifiers to describe various secondary objects and establish them in space, so that the figure interacted with the secondary object in a motion event. The differences between the tasks appeared to affect the provision of a label for a described object.

Overall scores, and many components, of the receptive and expressive measures correlated, suggesting multiple relations within students’ language development. Although correlations do not tell us which abilities develop first or which areas influence development in other areas, the current results support relations between one’s receptive language foundation and one’s ability to manipulate that foundation expressively, similar to earlier findings (Slobin et al., 2003). Overall, these two efficient and available measures can provide educators with a well-rounded snapshot of students’ language abilities from which to direct their individualized instruction. These measures might be used in tandem to document and monitor students’ language development across time, with these results as a means of comparison for student performance. Finally, these results reinforce the need for early and effective language instruction for all deaf students.

Implications

Although DoDP may establish native-like development of children’s ASL skills, the current data document the variation within a more typical D/HH population, or those students who likely do not acquire ASL early and who may have limited interactions with fluent ASL models. Students’ receptive and expressive skills continued to develop across the school-aged range, unlike their typically hearing peers. Educators cannot assume that neither students comprehend all information presented in ASL nor that comprehension increases with age. Nor can they assume students are able to accurately express all ASL concepts. However, educators can use these findings to direct next steps for instruction, such as instruction in the earlier acquired categories of action and location prior to instruction in the more complex areas of role shift and conditionals. In light of current results and the call for data-driven instruction (CAEP, 2010; Common Core State Standards Initiative, 2010; IDEIA, 2004; NCLB, 2002), educators must document students’ receptive and expressive ASL skills and target their instruction to those constructs not yet understood or produced.

Limitations

Specific background details were not collected from students; future collection of this information could parse factors related to language development. For example, because some older students entered the residential school at later ages, they may have been exposed to similar amounts of ASL as younger students but beginning when they were older. Although current results support earlier findings for classifier elicitation from both students (Beal-Alvarez & Easterbrooks, 2013) and adults (Beal-Alvarez & Easterbrooks, 2012), future investigations might focus on convergent and divergent validity among these stimuli and the ASL-RST.

Conclusion

The ASL-RST and OMS appear to be viable assessments to capture the variation and development of students’ ASL skills across ages and experiences. Relations among the measures indicate receptive and expressive areas that may develop in tandem. Future investigations of students’ and adults’ receptive and expressive ASL skills should be conducted across a similar student body to support current conclusions and document students’ performance across ages and time.

Conflicts of Interest

No conflicts of interest were reported.
References


